

**POPULATION ESTIMATES FOR PEARY  
CARIBOU (MINTO INLET HERD), DOLPHIN  
AND UNION CARIBOU, AND MUSKOX ON  
NORTHWEST VICTORIA ISLAND, NT,  
JULY 1998**



Northwest Territories Environment and Natural Resources



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## ABSTRACT

A stratified strip transect aerial survey was conducted in the area north of Minto Inlet and west of the Shaler Mountains, northwest Victoria, NWT to document the numbers and distribution of Peary caribou (*Rangifer tarandus pearyi*) and muskox (*Ovibos moschatus*) during early July 1998. We observed a total of 103 non-calf and 25 calf caribou on transect giving estimates of  $518 \pm 210$  (95% CI) non-calf and  $127 \pm 87$  (95% CI) calf caribou. Approximately 18.1% of the caribou observed were calves. Overall, there were 0.014 non-calf caribou per km<sup>2</sup> in the survey area. The survey area included the range of the Minto Inlet herd and the northwestern portion of the range of the Dolphin & Union herd.

We observed 19 non-calf and 3 calf caribou giving estimates of  $95 \pm 60$  (95% CI) non-calf and  $15 \pm 16$  (95% CI) calf caribou within the range of the Minto Inlet herd in the survey area. Approximately 12% of caribou observed were calves. The results of this survey indicate that the Minto Inlet herd has not disappeared and that some recovery of this herd occurred between 1994 and 1998.

We observed 84 non-calf and 22 calf caribou giving estimates of  $423 \pm 201$  (95% CI) non-calf and  $111 \pm 86$  (95% CI) calf caribou within the range of the Dolphin & Union herd in the survey area. Approximately 19.3% of these were calves. The Dolphin & Union herd appears to have expanded its range into the area immediately west of the Shaler Mountains north to the area between Richard Collinson Inlet and Glenelg Bay between 1994 and 1998.

We observed a total of 3,763 non-calf and 808 calf muskoxen on transect giving estimates of  $18,795 \pm 2,869$  (95% CI) non-calf and  $4,034 \pm 639$  (95% CI) calf muskoxen. Approximately 17.6% of the muskoxen observed were calves. Overall there were 0.522 non-calf muskoxen per km<sup>2</sup> within the survey area. There is a large population of muskoxen in the area, with most being in the area around the north shore of Minto Inlet.

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## INTRODUCTION

The history of the decline of the Minto Inlet caribou (*Rangifer tarandus*) herd on northwest Victoria Island, NT has been described by Gunn (2003) and Nishi and Buckland (2000). Gunn and Fournier (2000) defined the seasonal ranges of this herd. Recent nuclear DNA analysis of caribou tissues (Zittlau *et al.*, in prep.) indicated that the Minto Inlet and Dolphin and Union herds on Victoria Island are distinct from each other and the Minto Inlet herd is most closely related to caribou on Banks Island. Minto Inlet and Banks Island caribou are considered to be Peary caribou (*Rangifer tarandus pearyi*).

Nishi and Buckland (2000) found few caribou in the area west of the Shaler Mountains and north of Minto Inlet during a survey conducted on northwest Victoria Island during early June 1994. Only 4 were seen on transect in the range of the Minto Inlet herd. These were observed west of Richard Collinson Inlet. A group of 6–10 caribou were observed along the coast between Richard Collinson Inlet and Glenelg Bay. Nagy (unpublished data) equipped 10 adult female caribou in this area with satellite collars during August 2003. Satellite location data obtained during 2003–2005 indicated that these caribou used the area south and east of Richard Collinson Inlet to the Shaler Mountains during the pre-calving to fall period. These caribou then migrated to and wintered on the mainland near Bathurst Inlet indicating that they were Dolphin and Union caribou (*Rangifer tarandus*) (Nagy, 2003–2005, unpublished data). The animals (Nishi and Buckland, 2000) observed east of Richard Collinson Inlet may have been

some of the first Dolphin and Union caribou to expand there range onto northwest Victoria Island.

The caribou and muskox populations on Banks Island have been surveyed every two to four years since 1982 (Latour, 1985; McLean *et al.*, 1986; McLean, 1992; McLean and Fraser, 1992; Nagy *et al.*, 2007b; Nagy *et al.*, 2007c; Nagy *et al.*, 2007d; Nagy *et al.*, 2007e; Nagy *et al.*, 2007e; Nagy *et al.*, 2007d; Nagy *et al.*, 2007e; Nagy *et al.*, 2007f; McLean *et al.*, 1986; McLean, 1992; McLean and Fraser, 1992; Nagy *et al.*, 2007b; Nagy *et al.*, 2007c; Nagy *et al.*, 2007d) The draft National Recovery Plan for Peary caribou recommended that these Banks Island and Minto Inlet Peary caribou populations should be surveyed during the same years to account for potential movement of animals between the two areas. A systematic aerial strip census surveys designed to obtain population estimates for and Peary caribou and muskox on Banks Island and northwest Victoria Island were conducted in July 1998. The objectives of the survey undertaken on northwest Victoria Island were as follows:

- to obtain estimates of the number of non-calf and calf caribou and muskoxen,
- to determine the status of the Minto Inlet Peary caribou herd,
- to document observations of wolves and den sites,
- to document the distribution of caribou and muskoxen,
- to recommend whether the current quotas for caribou and muskoxen are sustainable, and

- if necessary, recommend management options to facilitate recovery of the Minto Inlet Peary caribou population.

This report summarizes the results of survey complete on northwest Victoria Island during July 1998.

## METHODS

In order to conduct a strip transect survey, we partitioned northwest Victoria Island into survey blocks (Figure 1). Transects were oriented to intersect major river systems and drainages at approximately a 90° angle (Figure 2). All blocks were surveyed at 20% coverage (transects spaced at 5-km intervals).

The survey crews were comprised of a pilot, an observer in the left back seat and an observer/recorder in the front right seat of the aircraft (Helio Courier and Cessna 185). Transect lines were marked on 1:250,000 scale NTS maps for each survey block. These maps were used by the pilots to navigate along the transects. The aircraft flew at an altitude of 100 m above ground level and at an airspeed of 160 km/h.

Caribou were counted inside and outside of the boundaries of a 500-m wide strip on each side of the aircraft. Muskoxen were counted within the boundaries of the strip. Strip width was marked using wooden dowels taped to the wing struts (Cessna 185) or tape marker on a wire stretched between the tie-down rings and the fuselage (Helio Courier) using the formula:

$$w = W \times h \div H$$

where  $w$  is the calculated strip width on the ground,  $W$  is the chosen survey strip width,  $h$  is the height of the observer on the ground, and  $H$  is the chosen survey altitude (Norton-Griffiths, 1987). All sightings of wolves were recorded.

Caribou were classified as adults (cows and yearlings), bulls, calves, or unknown. Muskoxen were classified as adults (age  $\geq 1$  year) and calves (age  $< 1$  year). Observers were equipped with binoculars to help ensure that caribou and muskoxen were counted and classified accurately. If an observer had difficulty, the pilot flew the aircraft off transect and flew in a tight circle around the caribou or muskoxen, so that an accurate count and classification could be done. The pilot then flew the aircraft back to the transect and the survey resumed. The pilot recorded the sighting numbers on the 1:250,000 NTS maps.

We downloaded rasterized versions of the 1:250,000 NTS mapsheets covering northwest Victoria Island from Toporama ([http://toporama.cits.rncan.gc.ca/toporama\\_en.html](http://toporama.cits.rncan.gc.ca/toporama_en.html)). These were appended using PCI Geomatica software (Geomatica software Geomatica) to create a single raster covering the entire study area. The resulting digital map was imported into OziExplorer GPS software (OziExplorer GPS Mapping Software). We used OziExplorer to create waypoints at the start and end of each transect and to digitize the location of each observation made during the survey. The resulting OziExplorer waypoint files were parsed using Microsoft Excel and the data for each observation were then entered from the field data sheets. At the end of this process the survey data were geo-referenced. This allowed use to map the distribution of Peary caribou and muskoxen observed during the survey.

Shape files were created for each survey block so that total area of each could be measured using ArcView 3.2 GIS software (Environmental Systems Research Institute). The specifications of the projection used are as follows: UTM Zone 11, NAD 83.

The numbers of non-calf and calf caribou and muskoxen observed on and off transect for each transect was summarized using Microsoft Excel. The length of each transect was derived using the start and end point coordinates of each transect and the route function in OziExplorer.

The population estimates and associated statistics were calculated using the Aerial2 version 3.0 method 2 (Krebs, 1999). Estimates for non-calf, calf, and all caribou and muskoxen, respectively, were derived for each survey block. Population and variance estimates from each stratum were combined to derive an overall population and population variance estimate for non-calf, calf, and all caribou and muskoxen, respectively, in all survey blocks.

The estimation of population number and variance from stratified surveys is given in Compton *et al.* (1995) cited by Johnson *et al.* (2004). The total population number is the summation of individual stratum estimates (equation 1):

$$\hat{N}_{total} = \sum_{h=1}^L \hat{N}_h$$

where there are  $L$  strata units. Assuming that the selection of sample units within each stratum is independent of other strata units, the variance is estimated as the sum of individual variance estimates for each stratum (equation 2):

$$var_{total} = \sum_{h=1}^L var_h$$

Confidence intervals for the population estimate can be approximated by (equation 3):

$$\hat{N}_{total} \pm t \sqrt{\text{var}_{total}}$$

The degrees of freedom ( $d$ ) for the t-statistic can be approximated by the following formula (equation 4):

$$d = \frac{\left( \sum_{h=1}^L a_h s_h^2 \right)^2}{\left[ \sum_{h=1}^L \left( (a_h s_h^2)^2 / (n_h - 1) \right) \right]}$$

where  $a_h = N_h(N_h - n_h)/n_h$  where  $N_h$  is the possible number of transects in an individual block and  $n_h$  is the actual number of transects flown. The sample variance from each block is denoted as  $s^2$  in the above formula, and  $L$  is the total number of strata (Compton *et al.*, 1995) cited by Johnson *et al.* (2004). This assumes that the population estimates and variance estimates from each stratum are unbiased and independent.

We mapped the distribution of locations obtained for satellite collared Minto Inlet Peary caribou (Gunn and Fournier, 2000) and Dolphin and Union caribou (J. Nishi, unpublished data; J. Nagy, unpublished data) in relationship to the boundaries of the survey blocks. This was done to determine the relative probability that caribou observed in a survey block belonged to the Minto Inlet or Dolphin and Union herd.

Maps showing the distribution of caribou observed on and off transect, muskoxen observed on transect, and wolves on northwest Victoria Islands were created using ArcView (Environmental Systems Research Institute).

## RESULTS

The survey was completed during early July 1998 (need to verify dates).

Weather conditions were generally good throughout the survey period. All transect lines were flown as planned (Figure 2).

### Caribou

The distribution of non-calf and calf caribou observed during the survey is shown in Figures 3 and 4, respectively. Overall we observed a total of 103 non-calf and 25 calf caribou on transect giving estimates of  $518 \pm 210$  (95% CI) non-calf and  $126 \pm 87$  (95% CI) calf caribou in the area surveyed (Table 1). The total number of caribou observed on and off transect was 118 non-calf and 26 calf caribou. There were 22 calves per 100 non-calf caribou. Approximately 18.1% of the caribou observed were calves.

Figures 5 and 6 show the distribution of satellite-collared cow Minto Inlet Peary caribou and Dolphin and Union caribou in relation to the boundaries of the survey blocks. These data suggest that caribou observed in survey blocks A, B, and C were of the Minto Inlet Peary caribou herd, while those in survey block D were of the Dolphin and Union herd.

The total number of caribou observed on transect in survey blocks A, B, and C was 19 non-calf and 3 calf caribou giving estimates of  $95 \pm 60$  (95% CI) non-calf and  $15 \pm 16$  (95% CI) calf caribou for the Minto Inlet herd (Table 2). The total number of caribou observed on and off transect was 22 non-calf and 3 calf

caribou. There were 13.6 calves per 100 non-calf caribou. Approximately 12 percent of these were calves.

The total number of caribou observed on transect in survey block D was 84 non-calf and 22 calf caribou giving estimates of  $423 \pm 201$  (95% CI) non-calf and  $111 \pm 86$  (95% CI) calf caribou for Dolphin and Union caribou in the area (Table 2). The total number of caribou observed on and off transect was 96 non-calf and 23 calf caribou. There were 23.9 calves per 100 non-calf caribou. Approximately 19.3 percent of these were calves.

We did not observe any caribou mortality sites during the survey.

### Muskox

The distribution of non-calf and calf muskoxen observed during the survey is shown in Figures 7 and 8, respectively. We observed a total of 3763 non-calf and 808 calf muskoxen on transect giving estimates of  $18,795 \pm 2,869$  (95% CI) non-calf and  $4,034 \pm 639$  (95% CI) calf muskoxen on the island (Table 3). There were 21.5 calves per 100 non-calf muskoxen. Approximately 17.6% of the muskoxen observed were calves.

We observed 4 dead muskoxen during the survey. The majority of these were found in survey block C (Figure 9).

## Wolves

We observed a total of 5 wolves near the head of Richard Collinson Inlet (Figure 10). These were all within the range of the Minto Inlet Peary caribou herd.

## DISCUSSION

The results of our survey indicate that there were approximately  $518 \pm 210$  (95% CI) non-calf caribou within the  $36,021 \text{ km}^2$  area surveyed north of Minto Inlet and west of the Shaler Mountains on northwest Victoria Island. Approximately 18% or  $95 \pm 60$  (95% CI) of these caribou were found within the area used by satellite collared Minto Inlet Peary caribou during 1986–1988 (Gunn and Fournier, 2000) and were considered to be Minto Inlet Peary caribou. Approximately 82% or  $423 \pm 201$  (95% CI) of the caribou were found within an area documented through satellite telemetry during 2003–2005 as the northwestern extent of the pre-calving to fall ranges of the Dolphin and Union caribou herd (Nagy, unpublished data).

The results of this survey indicate that the Minto Inlet herd has not disappeared and that some recovery of this herd occurred between 1994 and 1998. The Dolphin and Union herd appears to have recently expanded its range into the area immediately west of the Shaler Mountains north to the area between Richard Collinson Inlet and Glenelg Bay. Very few caribou were observed in this area in June 1994 (Nishi and Buckland, 2000).

There were  $18,795 \pm 2,869$  non-calf muskoxen within the survey area. This was the first systematic survey of muskoxen on northwest Victoria Island

north of Minto Inlet and west of the Shaler Mountains. The highest numbers of muskoxen were observed in the area north of Minto Inlet between Walker Bay and the head of Minto Inlet.

Only 5 wolves were observed during the survey. These were found within the range of the Minto Inlet herd.

The area supports a large population of muskox. The majority of these are in the area between Walker Bay and the head of Minto Inlet and just north of the north coastline of Minto Inlet.

## ACKNOWLEDGEMENTS

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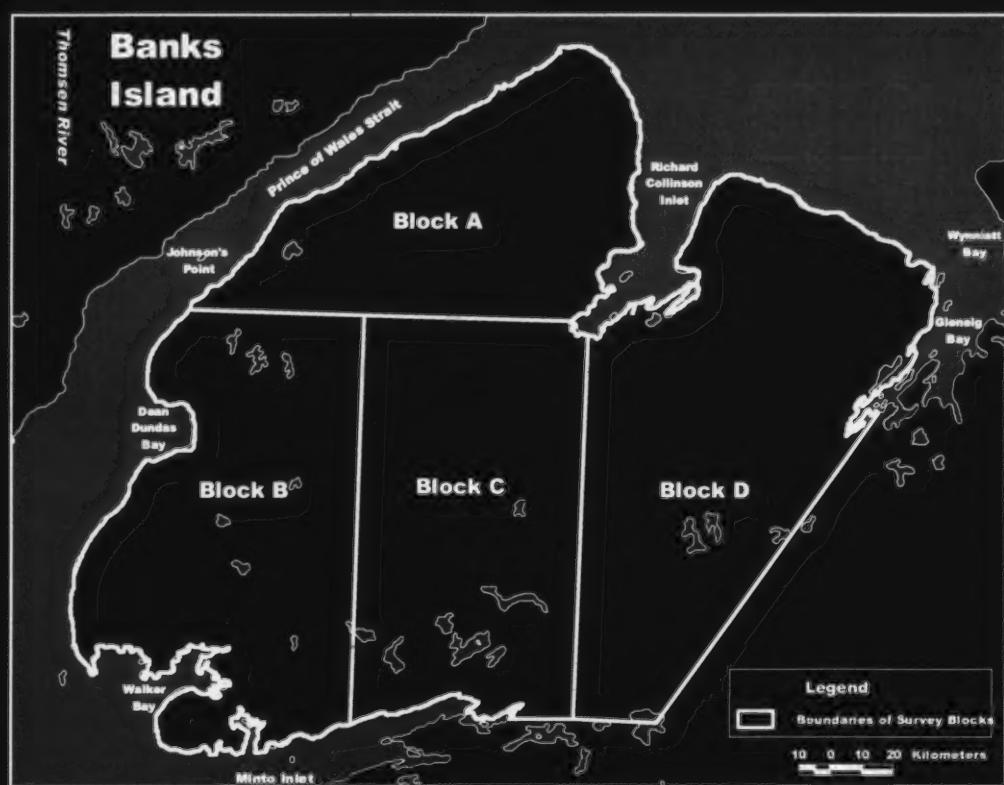
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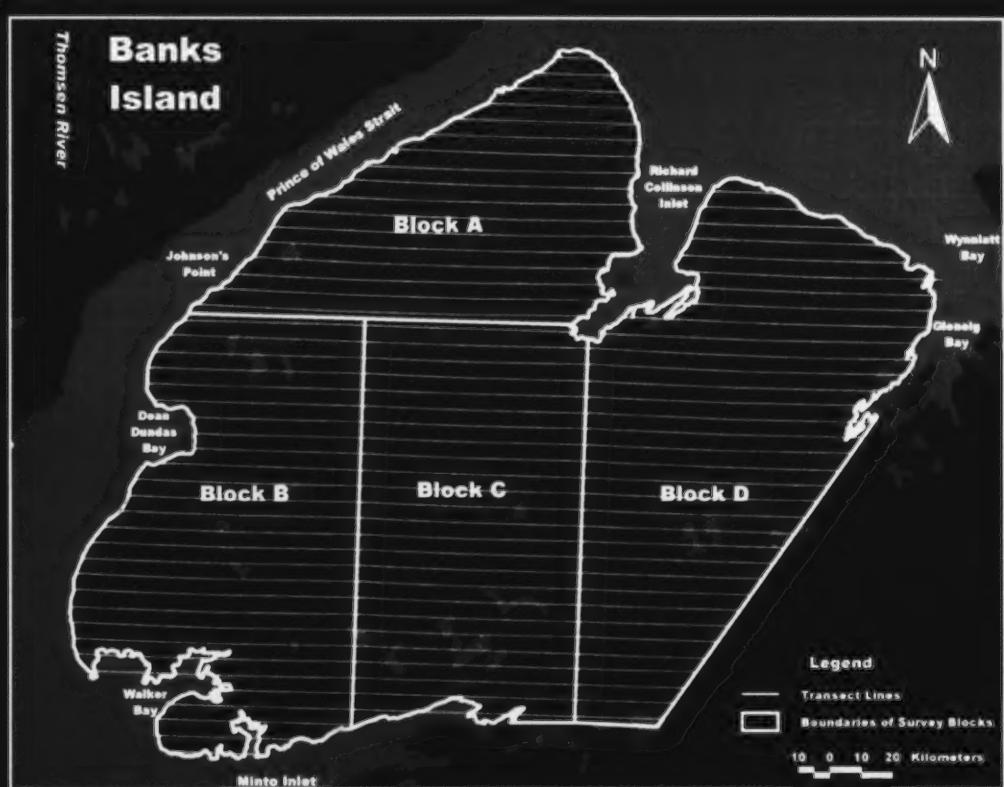
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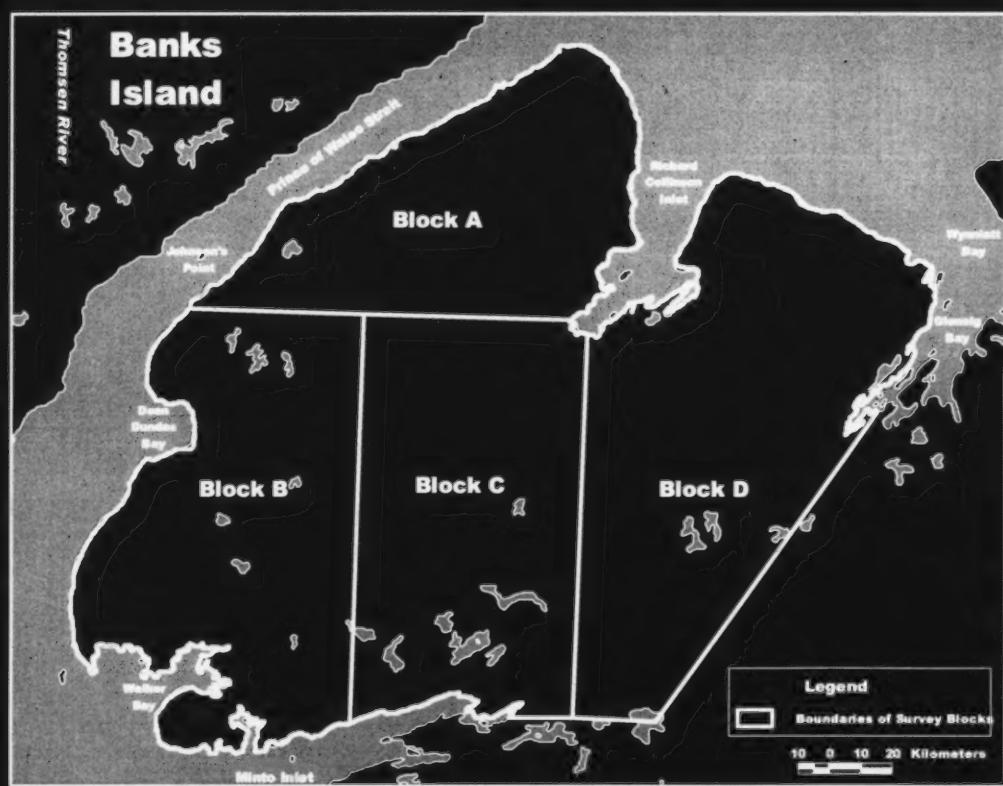
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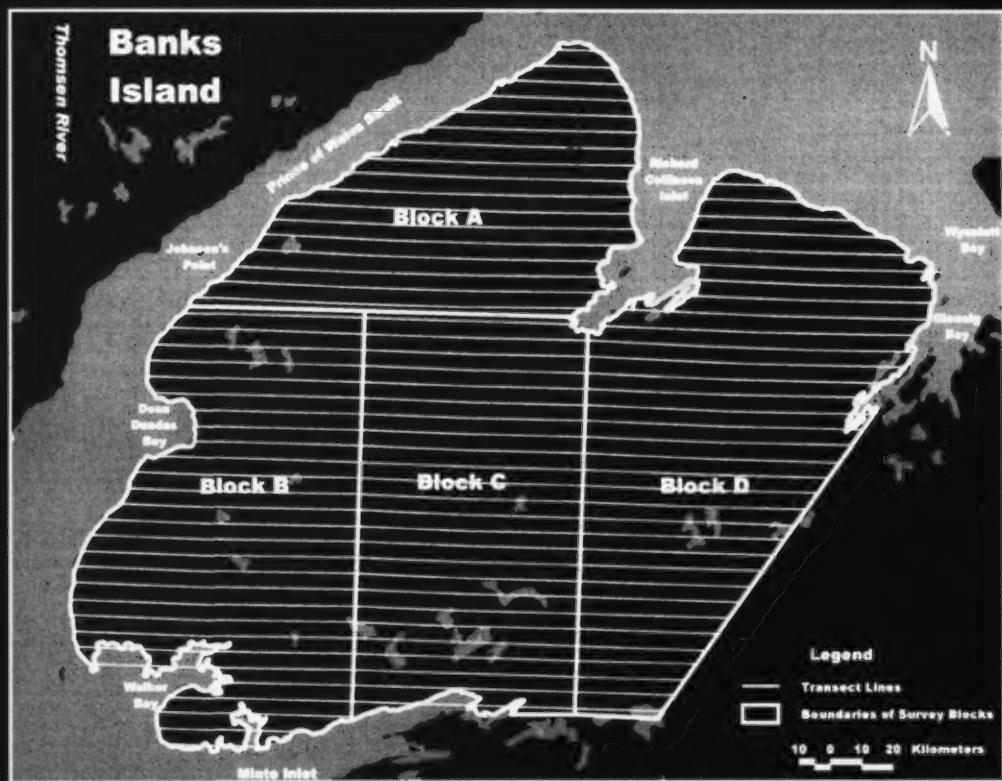
**Figure 1.** Location of survey blocks for the August 1998 northwest Victoria Island Peary caribou and muskoxen survey.



**Figure 2.** Distribution of survey blocks and transect lines for the August 1998 northwest Victoria Island survey as planned and flown.



**Figure 1.** Location of survey blocks for the August 1998 northwest Victoria Island Peary caribou and muskoxen survey.



**Figure 2.** Distribution of survey blocks and transect lines for the August 1998 northwest Victoria Island survey as planned and flown.



**Figure 3.** Distribution of non-calf caribou on northwest Victoria Island during July 1998.



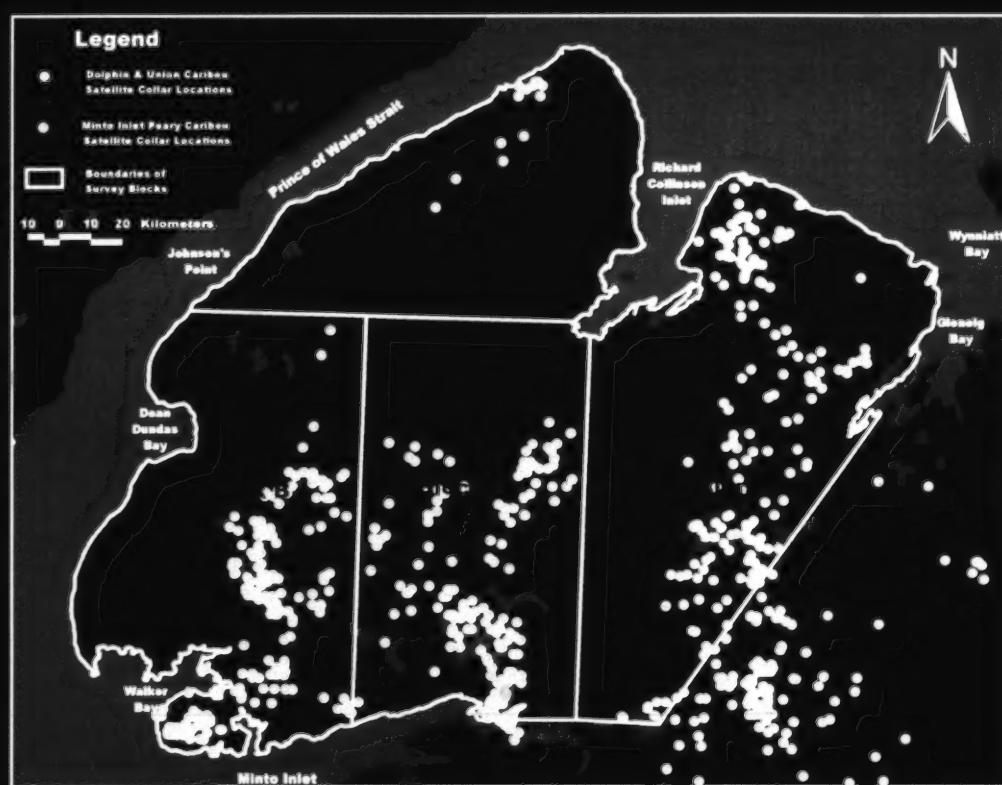
**Figure 4.** Distribution of calf caribou on northwest Victoria Island during July 1998.



**Figure 3.** Distribution of non-calf caribou on northwest Victoria Island during July 1998.



**Figure 4.** Distribution of calf caribou on northwest Victoria Island during July 1998.



**Figure 5.** Distribution of satellite collared cow Minto Inlet Peary caribou and Dolphin and Union caribou in relation to the boundaries of the survey blocks on northwest Victoria Island.<sup>A</sup>

<sup>A</sup> Satellite location data are from the followings sources:

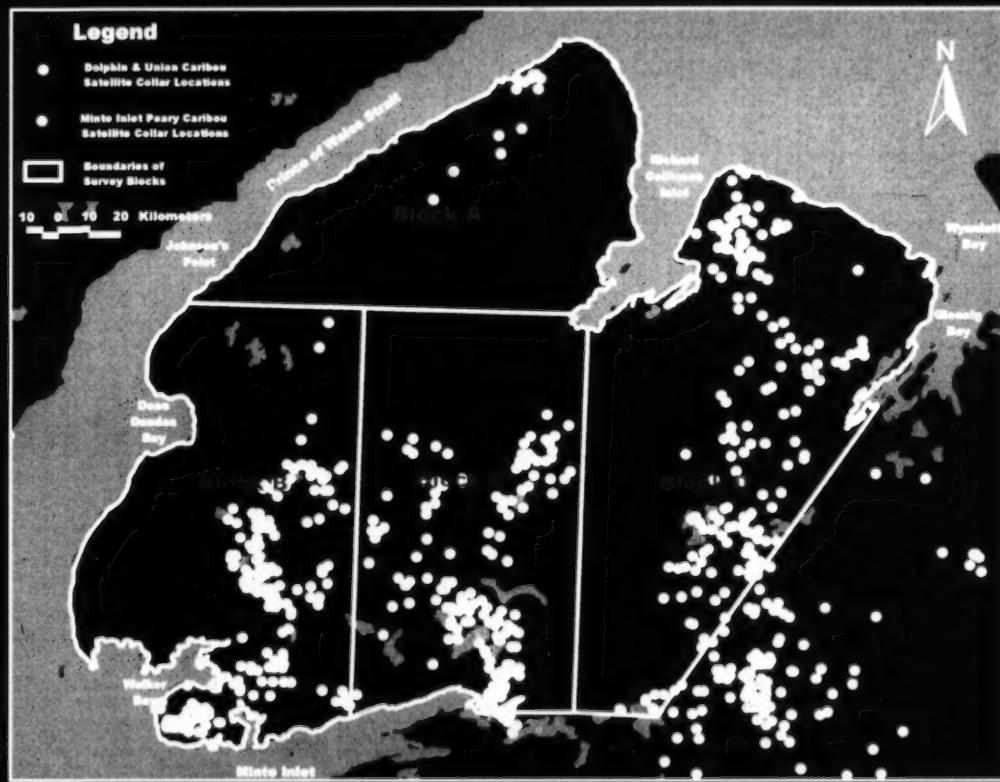
- Minto Inlet Peary caribou: 1987 to 1989 (Gunn and Fournier, 2000)
- Dolphin and Union caribou: 1996 to 1998 (J. Nishi, unpublished data) and 2003 to 2005 (J. Nagy, unpublished data)



**Figure 6.** Distribution of satellite collared cow Minto Inlet Peary caribou and Dolphin and Union caribou during 15 July to 15 August in relation to the boundaries of the survey blocks on northwest Victoria Island.<sup>A</sup>

<sup>A</sup> Satellite location data are from the followings sources:

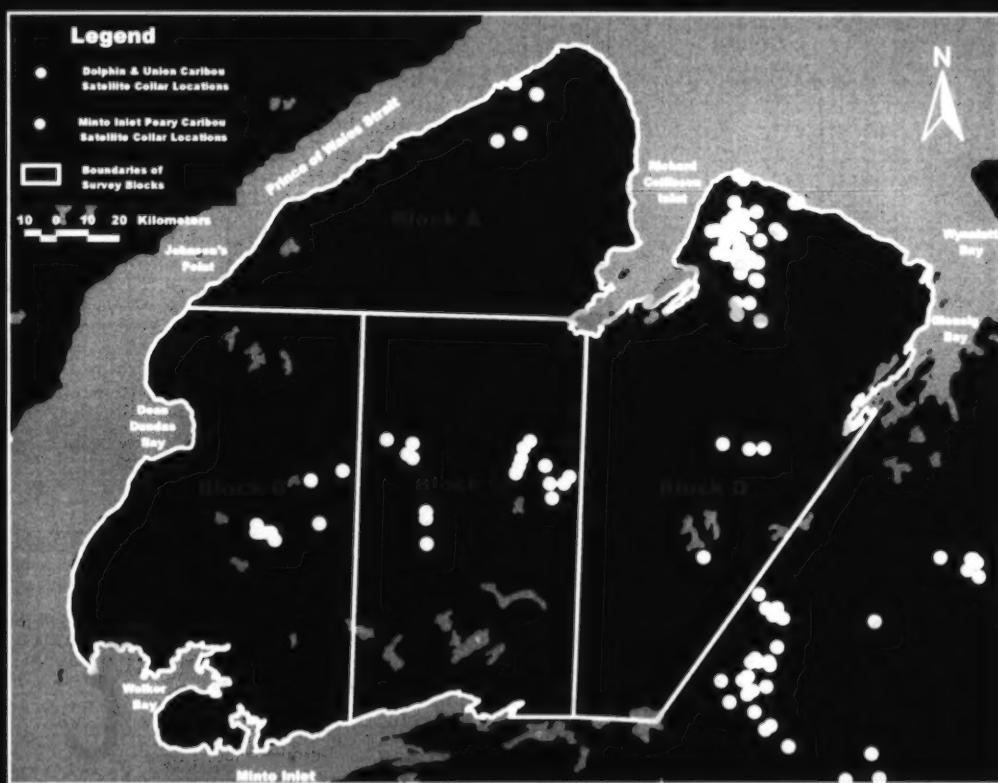
- Minto Inlet Peary caribou: 1987 to 1989 (Gunn and Fournier, 2000)
- Dolphin and Union caribou: 1996 to 1998 (J. Nishi, unpublished data) and 2003 to 2005 (J. Nagy, unpublished data)



**Figure 5.** Distribution of satellite collared cow Minto Inlet Peary caribou and Dolphin and Union caribou in relation to the boundaries of the survey blocks on northwest Victoria Island.<sup>A</sup>

<sup>A</sup> Satellite location data are from the following sources:

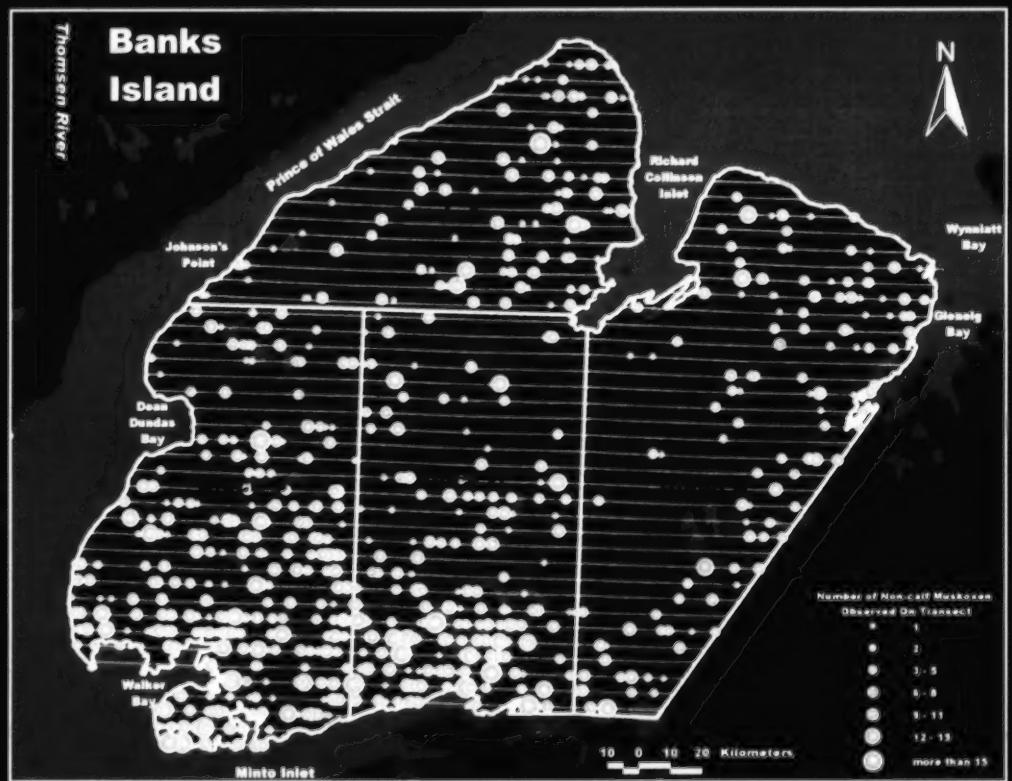
- Minto Inlet Peary caribou: 1987 to 1989 (Gunn and Fournier, 2000)
- Dolphin and Union caribou: 1996 to 1998 (J. Nishi, unpublished data) and 2003 to 2005 (J. Nagy, unpublished data)



**Figure 6.** Distribution of satellite collared cow Minto Inlet Peary caribou and Dolphin and Union caribou during 15 July to 15 August in relation to the boundaries of the survey blocks on northwest Victoria Island.<sup>A</sup>

<sup>A</sup> Satellite location data are from the followings sources:

- Minto Inlet Peary caribou: 1987 to 1989 (Gunn and Fournier, 2000)
- Dolphin and Union caribou: 1996 to 1998 (J. Nishi, unpublished data) and 2003 to 2005 (J. Nagy, unpublished data)



**Figure 7.** Distribution of non-calf muskoxen on northwest Victoria Island July 1998.



**Figure 8.** Distribution of calf muskoxen on northwest Victoria Island during July 1998.



**Figure 7.** Distribution of non-calf muskoxen on northwest Victoria Island July 1998.



**Figure 8.** Distribution of calf muskoxen on northwest Victoria Island during July 1998.



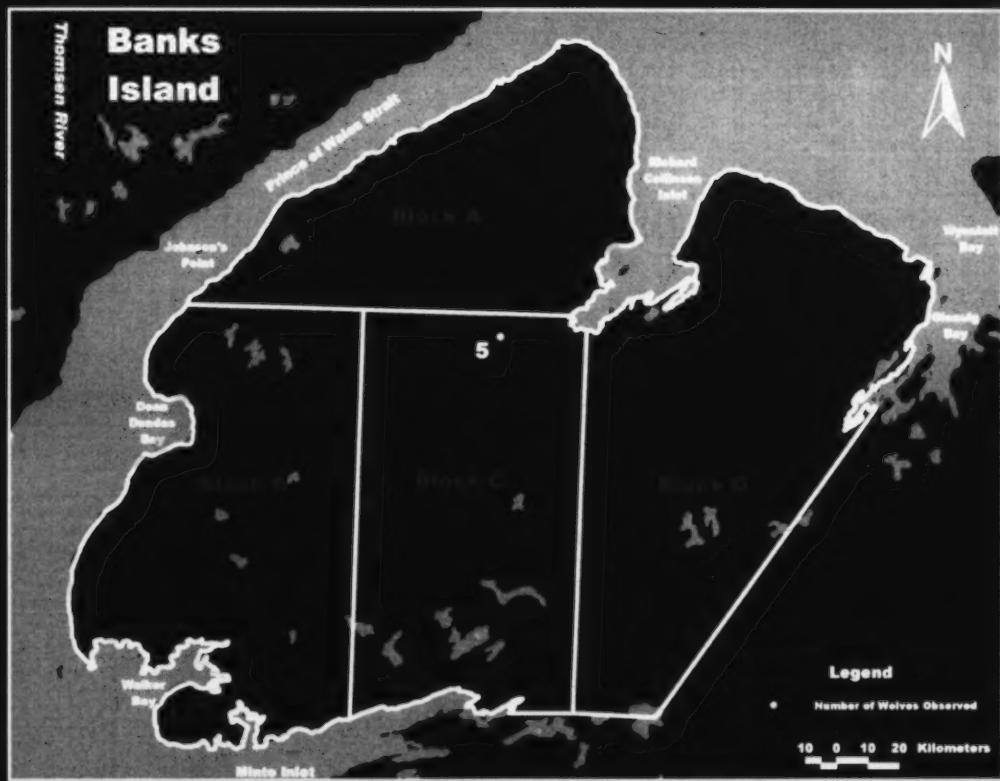
Figure 9. Distribution of dead muskoxen observed during the 1998 northwest Victoria Island caribou and muskoxen survey.



Figure 10. Distribution of wolves observed during the 1998 northwest Victoria Island caribou and muskoxen survey.



**Figure 9.** Distribution of dead muskoxen observed during the 1998 northwest Victoria Island caribou and muskoxen survey.



**Figure 10.** Distribution of wolves observed during the 1998 northwest Victoria Island caribou and muskoxen survey.

**Table 1.** Population estimates for caribou on northwest Victoria Island, July 1998.

| Survey<br>Blocks         | Census<br>Area<br>( km <sup>2</sup> ) | Number of<br>Transects<br>Flown | Number of<br>Possible<br>Transects | Density<br>(per km <sup>2</sup> ) | Population<br>Total | Variance<br>of<br>Totals | S.E.<br>of<br>Y | 95%<br>Confidence<br>Interval (±) | % of Total<br>Area<br>Sampled | Number<br>On<br>Transect | Number<br>Off<br>Transect | Coefficient<br>Of<br>Variation | df |
|--------------------------|---------------------------------------|---------------------------------|------------------------------------|-----------------------------------|---------------------|--------------------------|-----------------|-----------------------------------|-------------------------------|--------------------------|---------------------------|--------------------------------|----|
| <b>Caribou: Non-calf</b> |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| A                        | 7016                                  | 17                              | 85.4                               | 0.002                             | 15                  | 44.7                     | 6.7             | 14                                | 20.0                          | 3                        | 0                         | 0.445                          |    |
| B                        | 9257                                  | 28                              | 139.2                              | 0.002                             | 20                  | 315.3                    | 17.8            | 36                                | 20.0                          | 4                        | 0                         | 0.888                          |    |
| C                        | 8607                                  | 25                              | 128.2                              | 0.007                             | 60                  | 488.0                    | 22.1            | 46                                | 20.1                          | 12                       | 3                         | 0.371                          |    |
| D                        | 11141                                 | 34                              | 172                                | 0.038                             | 423                 | 9793.8                   | 99.0            | 201                               | 19.9                          | 84                       | 12                        | 0.234                          |    |
| sum of blocks            | 36021                                 | 104                             | 524.8                              | 0.014                             | 518                 | 10641.8                  | 103.2           | 210                               | 20.0                          | 103                      | 15                        | 0.199                          | 33 |
| <b>Caribou: Calf</b>     |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| A                        | 7016                                  | 17                              | 85.4                               | 0.001                             | 10                  | 34.4                     | 5.9             | 12                                | 20.0                          | 2                        | 0                         | 0.586                          |    |
| B                        | 9257                                  | 28                              | 139.2                              | 0.000                             | 0                   |                          |                 |                                   | 20.0                          | 0                        | 0                         |                                |    |
| C                        | 8607                                  | 25                              | 128.2                              | 0.001                             | 5                   | 21.2                     | 4.6             | 9                                 | 20.1                          | 1                        | 0                         | 0.925                          |    |
| D                        | 11141                                 | 34                              | 172                                | 0.010                             | 111                 | 1768.5                   | 42.1            | 86                                | 19.9                          | 22                       | 1                         | 0.380                          |    |
| sum of blocks            | 36021                                 | 104                             | 524.8                              | 0.003                             | 126                 | 1824.0                   | 42.7            | 87                                | 20.0                          | 25                       | 1                         | 0.340                          | 33 |
| <b>Caribou: Total</b>    |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| A                        | 7016                                  | 17                              | 85.4                               | 0.004                             | 25                  | 139.0                    | 11.8            | 25                                | 20.0                          | 5                        | 0                         | 0.471                          |    |
| B                        | 9257                                  | 28                              | 139.2                              | 0.002                             | 20                  | 315.3                    | 17.8            | 36                                | 20.0                          | 4                        | 0                         | 0.888                          |    |
| C                        | 8607                                  | 25                              | 128.2                              | 0.008                             | 65                  | 531.6                    | 23.1            | 48                                | 20.1                          | 13                       | 3                         | 0.357                          |    |
| D                        | 11141                                 | 34                              | 172                                | 0.048                             | 534                 | 18905.1                  | 137.5           | 280                               | 19.9                          | 106                      | 13                        | 0.258                          |    |
| sum of blocks            | 36021                                 | 104                             | 524.8                              | 0.018                             | 643                 | 19891.0                  | 141.0           | 287                               | 20.0                          | 128                      | 16                        | 0.219                          | 33 |

**Table 2.** Population estimates for Peary caribou (Minto Inlet herd) and Dolphin and Union caribou on northwest Victoria Island, July 1998.

| Survey<br>Blocks                 | Census<br>Area<br>( km <sup>2</sup> ) | Number of<br>Transects<br>Flown | Number of<br>Possible<br>Transects | Density<br>(per km <sup>2</sup> ) | Population<br>Total | Variance<br>of<br>Totals | S.E.<br>of<br>Y | 95%<br>Confidence<br>Interval (±) | % of Total<br>Area<br>Sampled | Number<br>On<br>Transect | Number<br>Off<br>Transect | Coefficient<br>Of<br>Variation | df |
|----------------------------------|---------------------------------------|---------------------------------|------------------------------------|-----------------------------------|---------------------|--------------------------|-----------------|-----------------------------------|-------------------------------|--------------------------|---------------------------|--------------------------------|----|
| <b>Minto Inlet Peary Caribou</b> |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| Caribou: Non-Calf                |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| A                                | 7016                                  | 17                              | 85.4                               | 0.002                             | 15                  | 44.7                     | 6.7             | 14                                | 20.0                          | 3                        | 0                         | 0.445                          |    |
| B                                | 9257                                  | 28                              | 139.2                              | 0.002                             | 20                  | 315.3                    | 17.8            | 36                                | 20.0                          | 4                        | 0                         | 0.888                          |    |
| C                                | 8607                                  | 25                              | 128.2                              | 0.007                             | 60                  | 488.0                    | 22.1            | 46                                | 20.1                          | 12                       | 3                         | 0.371                          |    |
| sum of blocks                    | 24880                                 | 70                              | 352.8                              | 0.004                             | 95                  | 848.0                    | 29.1            | 60                                | 28.9                          | 19                       | 3                         | 0.308                          | 25 |
| Caribou: Calf                    |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| A                                | 7016                                  | 17                              | 85.4                               | 0.001                             | 10                  | 34.4                     | 5.9             | 12                                | 20.0                          | 2                        | 0                         | 0.586                          |    |
| B                                | 9257                                  | 28                              | 139.2                              | 0.000                             | 0                   |                          |                 |                                   | 20.0                          | 0                        | 0                         |                                |    |
| C                                | 8607                                  | 25                              | 128.2                              | 0.001                             | 5                   | 21.2                     | 4.6             | 9                                 | 20.1                          | 1                        | 0                         | 0.925                          |    |
| sum of blocks                    | 24880                                 | 70                              | 352.8                              | 0.001                             | 15                  | 55.5                     | 7.5             | 16                                | 28.9                          | 3                        | 0                         | 0.497                          | 19 |
| Caribou: Total                   |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| A                                | 7016                                  | 17                              | 85.4                               | 0.004                             | 25                  | 139.0                    | 11.8            | 25                                | 20.0                          | 5                        | 0                         | 0.471                          |    |
| B                                | 9257                                  | 28                              | 139.2                              | 0.002                             | 20                  | 315.3                    | 17.8            | 36                                | 20.0                          | 4                        | 0                         | 0.888                          |    |
| C                                | 8607                                  | 25                              | 128.2                              | 0.008                             | 65                  | 531.6                    | 23.1            | 48                                | 20.1                          | 13                       | 3                         | 0.357                          |    |
| sum of blocks                    | 24880                                 | 70                              | 352.8                              | 0.004                             | 110                 | 985.9                    | 31.4            | 65                                | 28.9                          | 22                       | 3                         | 0.287                          | 24 |
| <b>Dolphin and Union Caribou</b> |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| Caribou: Non-Calf                |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| D                                | 11,141                                | 34                              | 172.0                              | 0.038                             | 423                 | 9793.8                   | 99.0            | 201                               | 19.9                          | 84                       | 12                        | 0.234                          | 33 |
| Caribou: Calf                    |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| D                                | 11,141                                | 34                              | 172.0                              | 0.010                             | 111                 | 1768.5                   | 42.1            | 86                                | 19.9                          | 22                       | 1                         | 0.380                          | 33 |
| Caribou: Calf                    |                                       |                                 |                                    |                                   |                     |                          |                 |                                   |                               |                          |                           |                                |    |
| D                                | 11,141                                | 34                              | 172.0                              | 0.048                             | 534                 | 18905.1                  | 137.5           | 280                               | 19.9                          | 106                      | 13                        | 0.258                          | 33 |

**Table 3.** Population estimates for muskox on northwest Victoria Island, July 1998.

| Survey<br>Blocks        | Census<br>Area<br>(km <sup>2</sup> ) | Number of<br>Transects<br>Flown | Number of<br>Possible<br>Transects | Density<br>(per km <sup>2</sup> ) | Population<br>Total | Variance<br>of<br>Totals | S.E.<br>of<br>Y | 95%<br>Confidence<br>Interval ( $\pm$ ) | % of Total<br>Area<br>Sampled | Number<br>On<br>Transect | Number<br>Off<br>Transect | Coefficient<br>Of<br>Variation | df |
|-------------------------|--------------------------------------|---------------------------------|------------------------------------|-----------------------------------|---------------------|--------------------------|-----------------|---|-------------------------------|--------------------------|---------------------------|--------------------------------|----|
| <b>Muskox: Non-calf</b> |                                      |                                 |                                    |                                   |                     |                          |                 |   |                               |                          |                           |                                |    |
| A                       | 7016                                 | 17                              | 85.4                               | 0.321                             | 2251                | 23595.2                  | 153.6           | 326                                     | 20.0                          | 450                      | not recorded              | 0.068                          |    |
| B                       | 9257                                 | 28                              | 139.2                              | 0.901                             | 8340                | 903612.5                 | 950.6           | 1951                                    | 20.0                          | 1669                     | not recorded              | 0.114                          |    |
| C                       | 8607                                 | 25                              | 128.2                              | 0.624                             | 5369                | 900367.8                 | 948.9           | 1958                                    | 20.1                          | 1081                     | not recorded              | 0.177                          |    |
| D                       | 11141                                | 34                              | 172                                | 0.254                             | 2835                | 112374.4                 | 335.2           | 682                                     | 19.9                          | 563                      | not recorded              | 0.118                          |    |
| sum of blocks           | 36021                                | 104                             | 524.8                              | 0.522                             | 18795               | 1939949.9                | 1392.8          | 2869                                    | 20.0                          | 3763                     |                           | 0.074                          | 26 |
| <b>Muskox: Calf</b>     |                                      |                                 |                                    |                                   |                     |                          |                 |   |                               |                          |                           |                                |    |
| A                       | 7016                                 | 17                              | 85.4                               | 0.064                             | 450                 | 2641.5                   | 51.4            | 109                                     | 20.0                          | 90                       | not recorded              | 0.114                          |    |
| B                       | 9257                                 | 28                              | 139.2                              | 0.185                             | 1709                | 31085.8                  | 176.3           | 362                                     | 20.0                          | 342                      | not recorded              | 0.103                          |    |
| C                       | 8607                                 | 25                              | 128.2                              | 0.154                             | 1326                | 56337.3                  | 237.4           | 490                                     | 20.1                          | 267                      | not recorded              | 0.179                          |    |
| D                       | 11141                                | 34                              | 172                                | 0.049                             | 549                 | 5813.9                   | 76.2            | 155                                     | 19.9                          | 109                      | not recorded              | 0.139                          |    |
| sum of blocks           | 36021                                | 104                             | 524.8                              | 0.112                             | 4034                | 95878.5                  | 309.6           | 639                                     | 20.0                          | 808                      |                           | 0.077                          | 25 |
| <b>Muskox: Total</b>    |                                      |                                 |                                    |                                   |                     |                          |                 |   |                               |                          |                           |                                |    |
| A                       | 7016                                 | 17                              | 85.4                               | 0.385                             | 2701                | 34645.0                  | 186.1           | 395                                     | 20.0                          | 540                      | not recorded              | 0.069                          |    |
| B                       | 9257                                 | 28                              | 139.2                              | 1.086                             | 10049               | 1241631.9                | 1114.3          | 2287                                    | 20.0                          | 2011                     | not recorded              | 0.111                          |    |
| C                       | 8607                                 | 25                              | 128.2                              | 0.778                             | 6695                | 1373171.6                | 1171.8          | 2419                                    | 20.1                          | 1348                     | not recorded              | 0.175                          |    |
| D                       | 11141                                | 34                              | 172                                | 0.304                             | 3383                | 158835.9                 | 398.5           | 811                                     | 19.9                          | 672                      | not recorded              | 0.118                          |    |
| sum of blocks           | 36021                                | 104                             | 524.8                              | 0.634                             | 22829               | 280284.4                 | 1675.8          | 3451                                    | 20.0                          | 4571                     |                           | 0.073                          | 25 |

## APPENDIX A.

Transect data for the 1998 northwest Victoria Island caribou and muskoxen survey.

| Survey Block | Transect Number | Area (km <sup>2</sup> ) | Transect          |               |                | Muskox: Non-calf | Muskox: Calf | Muskox: Total |
|--------------|-----------------|-------------------------|-------------------|---------------|----------------|------------------|--------------|---------------|
|              |                 |                         | Caribou: Non-calf | Caribou: Calf | Caribou: Total |                  |              |               |
| A            | A01             | 12.846                  | 0                 | 0             | 0              | 0                | 0            | 0             |
|              | A02             | 25.549                  | 0                 | 0             | 0              | 15               | 2            | 17            |
|              | A03             | 38.909                  | 0                 | 0             | 0              | 7                | 0            | 7             |
|              | A04             | 44.877                  | 0                 | 0             | 0              | 25               | 7            | 32            |
|              | A05             | 57.427                  | 0                 | 0             | 0              | 16               | 6            | 22            |
|              | A06             | 66.288                  | 0                 | 0             | 0              | 9                | 0            | 9             |
|              | A07             | 76.273                  | 0                 | 0             | 0              | 23               | 3            | 26            |
|              | A08             | 85.553                  | 0                 | 0             | 0              | 28               | 5            | 33            |
|              | A09             | 87.554                  | 0                 | 0             | 0              | 39               | 4            | 43            |
|              | A10             | 99.058                  | 0                 | 0             | 0              | 37               | 4            | 41            |
|              | A11             | 109.006                 | 0                 | 0             | 0              | 32               | 9            | 41            |
|              | A12             | 113.650                 | 0                 | 0             | 0              | 44               | 8            | 52            |
|              | A13             | 116.410                 | 1                 | 1             | 2              | 19               | 3            | 22            |
|              | A14             | 110.870                 | 0                 | 0             | 0              | 32               | 12           | 44            |
|              | A15             | 114.433                 | 0                 | 0             | 0              | 48               | 11           | 59            |
|              | A16             | 120.754                 | 1                 | 1             | 2              | 33               | 7            | 40            |
|              | A17             | 123.023                 | 1                 | 0             | 1              | 43               | 9            | 52            |
|              | Total           | 1402.480                | 3                 | 2             | 5              | 450              | 90           | 540           |
| B            | B01             | 56.500                  | 0                 | 0             | 0              | 18               | 6            | 24            |
|              | B02             | 60.839                  | 0                 | 0             | 0              | 28               | 7            | 35            |
|              | B03             | 65.233                  | 0                 | 0             | 0              | 26               | 7            | 33            |
|              | B04             | 67.019                  | 0                 | 0             | 0              | 24               | 9            | 33            |
|              | B05             | 67.170                  | 0                 | 0             | 0              | 1                | 0            | 1             |
|              | B06             | 65.340                  | 0                 | 0             | 0              | 16               | 3            | 19            |
|              | B07             | 52.446                  | 0                 | 0             | 0              | 0                | 0            | 0             |
|              | B08             | 51.616                  | 0                 | 0             | 0              | 19               | 4            | 23            |
|              | B09             | 51.860                  | 0                 | 0             | 0              | 48               | 10           | 58            |
|              | B10             | 62.247                  | 0                 | 0             | 0              | 31               | 9            | 40            |
|              | B11             | 69.908                  | 4                 | 0             | 4              | 11               | 0            | 11            |
|              | B12             | 72.016                  | 0                 | 0             | 0              | 53               | 16           | 69            |
|              | B13             | 74.030                  | 0                 | 0             | 0              | 51               | 9            | 60            |
|              | B14             | 79.647                  | 0                 | 0             | 0              | 89               | 23           | 112           |
|              | B15             | 83.226                  | 0                 | 0             | 0              | 98               | 25           | 123           |
|              | B16             | 86.055                  | 0                 | 0             | 0              | 77               | 19           | 96            |
|              | B17             | 87.812                  | 0                 | 0             | 0              | 72               | 17           | 89            |
|              | B18             | 88.405                  | 0                 | 0             | 0              | 97               | 18           | 115           |
|              | B19             | 89.066                  | 0                 | 0             | 0              | 50               | 11           | 61            |
|              | B20             | 88.797                  | 0                 | 0             | 0              | 133              | 25           | 158           |
|              | B21             | 87.913                  | 0                 | 0             | 0              | 156              | 30           | 186           |
|              | B22             | 64.114                  | 0                 | 0             | 0              | 111              | 17           | 128           |
|              | B23             | 56.163                  | 0                 | 0             | 0              | 39               | 6            | 45            |

| Survey Block | Transect Number | Transect                |                   | Caribou: Total | Muskox: Non-calf | Muskox: Calf | Muskox: Total |
|--------------|-----------------|-------------------------|-------------------|----------------|------------------|--------------|---------------|
|              |                 | Area (km <sup>2</sup> ) | Caribou: Non-calf |                |                  |              |               |
|              | B24             | 38.279                  | 0                 | 0              | 75               | 18           | 93            |
|              | B25             | 57.340                  | 0                 | 0              | 41               | 6            | 47            |
|              | B26             | 57.305                  | 0                 | 0              | 127              | 24           | 151           |
|              | B27             | 48.379                  | 0                 | 0              | 89               | 14           | 103           |
|              | B28             | 23.693                  | 0                 | 0              | 89               | 9            | 98            |
|              | Total           | 1852.418                | 4                 | 0              | 1669             | 342          | 2011          |
| C            | C01             | 66.554                  | 0                 | 0              | 8                | 3            | 11            |
|              | C02             | 70.117                  | 0                 | 0              | 24               | 5            | 29            |
|              | C03             | 70.118                  | 0                 | 0              | 0                | 0            | 0             |
|              | C04             | 70.117                  | 0                 | 0              | 14               | 3            | 17            |
|              | C05             | 70.117                  | 0                 | 0              | 27               | 4            | 31            |
|              | C06             | 70.116                  | 0                 | 0              | 12               | 3            | 15            |
|              | C07             | 70.116                  | 0                 | 0              | 12               | 5            | 17            |
|              | C08             | 70.118                  | 0                 | 0              | 17               | 6            | 23            |
|              | C09             | 70.108                  | 0                 | 0              | 0                | 1            | 0             |
|              | C10             | 70.071                  | 1                 | 0              | 1                | 14           | 7             |
|              | C11             | 70.101                  | 0                 | 0              | 34               | 7            | 41            |
|              | C12             | 70.063                  | 0                 | 0              | 41               | 11           | 52            |
|              | C13             | 70.113                  | 1                 | 0              | 1                | 22           | 3             |
|              | C14             | 70.024                  | 4                 | 0              | 4                | 15           | 19            |
|              | C15             | 70.081                  | 0                 | 0              | 0                | 41           | 13            |
|              | C16             | 70.111                  | 2                 | 0              | 2                | 18           | 4             |
|              | C17             | 70.088                  | 1                 | 1              | 2                | 18           | 5             |
|              | C18             | 69.991                  | 2                 | 0              | 2                | 48           | 11            |
|              | C19             | 70.095                  | 0                 | 0              | 0                | 70           | 13            |
|              | C20             | 70.074                  | 0                 | 0              | 0                | 114          | 20            |
|              | C21             | 70.068                  | 1                 | 0              | 1                | 140          | 27            |
|              | C22             | 70.067                  | 0                 | 0              | 0                | 96           | 36            |
|              | C23             | 70.082                  | 0                 | 0              | 0                | 87           | 24            |
|              | C24             | 69.981                  | 0                 | 0              | 0                | 114          | 33            |
|              | C25             | 54.548                  | 0                 | 0              | 0                | 94           | 20            |
|              | Total           | 1733.039                | 12                | 1              | 13               | 1081         | 267           |
| D            | D01             | 21.882                  | 0                 | 0              | 0                | 0            | 0             |
|              | D02             | 31.395                  | 14                | 8              | 22               | 4            | 0             |
|              | D03             | 49.800                  | 5                 | 2              | 7                | 25           | 7             |
|              | D04             | 60.363                  | 2                 | 1              | 3                | 8            | 2             |
|              | D05             | 70.727                  | 9                 | 2              | 11               | 14           | 4             |
|              | D06             | 79.748                  | 3                 | 0              | 3                | 17           | 6             |
|              | D07             | 74.660                  | 14                | 3              | 17               | 43           | 8             |
|              | D08             | 79.575                  | 5                 | 2              | 7                | 51           | 10            |
|              | D09             | 95.673                  | 8                 | 2              | 10               | 22           | 2             |
|              | D10             | 98.320                  | 1                 | 0              | 1                | 24           | 3             |
|              | D11             | 102.524                 | 3                 | 0              | 3                | 24           | 4             |
|              | D12             | 95.829                  | 0                 | 0              | 0                | 2            | 0             |
|              | D13             | 91.743                  | 0                 | 0              | 0                | 20           | 6             |
|              | D14             | 88.570                  | 1                 | 0              | 1                | 30           | 4             |

| Survey Block | Transect Number | Area (km <sup>2</sup> ) | Transect          |               |                | Muskox: Non-calf | Muskox: Calf | Muskox: Total |
|--------------|-----------------|-------------------------|-------------------|---------------|----------------|------------------|--------------|---------------|
|              |                 |                         | Caribou: Non-calf | Caribou: Calf | Caribou: Total |                  |              |               |
|              | D15             | 87.508                  | 0                 | 0             | 0              | 10               | 2            | 12            |
|              | D16             | 87.728                  | 1                 | 0             | 1              | 13               | 3            | 16            |
|              | D17             | 84.408                  | 0                 | 0             | 0              | 2                | 0            | 2             |
|              | D18             | 80.702                  | 1                 | 0             | 1              | 34               | 7            | 41            |
|              | D19             | 77.503                  | 1                 | 0             | 1              | 9                | 5            | 14            |
|              | D20             | 74.250                  | 2                 | 0             | 2              | 9                | 1            | 10            |
|              | D21             | 70.749                  | 0                 | 0             | 0              | 15               | 1            | 16            |
|              | D22             | 67.292                  | 1                 | 0             | 1              | 5                | 2            | 7             |
|              | D23             | 64.192                  | 2                 | 0             | 2              | 17               | 3            | 20            |
|              | D24             | 60.835                  | 1                 | 1             | 2              | 0                | 0            | 0             |
|              | D25             | 57.622                  | 0                 | 0             | 0              | 23               | 2            | 25            |
|              | D26             | 54.140                  | 3                 | 0             | 3              | 4                | 0            | 4             |
|              | D27             | 50.973                  | 1                 | 0             | 1              | 10               | 2            | 12            |
|              | D28             | 47.637                  | 3                 | 0             | 0              | 8                | 3            | 11            |
|              | D29             | 44.331                  | 2                 | 0             | 3              | 21               | 7            | 28            |
|              | D30             | 40.749                  | 0                 | 1             | 3              | 16               | 2            | 18            |
|              | D31             | 37.883                  | 0                 | 0             | 0              | 7                | 0            | 7             |
|              | D32             | 34.417                  | 0                 | 0             | 0              | 24               | 0            | 24            |
|              | D33             | 31.255                  | 1                 | 0             | 1              | 18               | 7            | 25            |
|              | D34             | 17.876                  | 0                 | 0             | 0              | 34               | 6            | 40            |
|              | Total           | 2212.859                | 84                | 22            | 106            | 563              | 109          | 672           |





